XI. Herbicides

Herbicides are chemicals used to kill unwanted plants. They can be very effective tools for restoring SNAs on a landscape scale but can also be destructive if used in the wrong way. Remember it is much easier to destroy a remnant plant community than to restore it. Use herbicides very thoughtfully around rare plant communities. There may be other options- look into them if you are dealing with a sensitive area.

Herbicides have several different names. The trade name or common name is the name a company gives to an herbicide (ex: Garlon 4). It might change even though the same chemical composition is used. The chemical name of the herbicide identifies the active ingredient (ex: triclopyr).

Herbicides can be divided into two main groups. The two main groupings are contact herbicides and systemic herbicides. Contact herbicides kill only the parts of the plant that the herbicide touches. They will show results quicker than systemic herbicides but may not kill the plant. Many invasives are able to resprout from the root after being treated with contact herbicides, therefore most of the chemicals we use are systemic herbicides. Systemic herbicides are absorbed through the leaves or stem of the plant and transported to all of the plant tissue. Some chemicals may take several days or weeks to show an effect. The speed of travel throughout the plant depends largely on soil and air temperature. Cooler temperatures slow herbicide travel, so a plant treated in the spring may take a week or two longer to show an effect than a plant treated in the summer. Precipitation can also impact herbicide effectiveness and speed as plant pathways tend to slow or shut down during dry periods, decreasing herbicide effectiveness.

Herbicides can also be categorized by their mode of action (the mechanism in which they kill plants). There are several types of herbicides listed below along with their target species:

Auxin (growth regulator) mimics: triclopyr, 2,4-D, clopyralid, aminopyralid

Target species: These herbicides focus on broadleaves. Some of these herbicides are more generalists while clopyralid and aminopyralid only control certain families of broadleaves.

Amino acid inhibitor: glyphosate, imazapyr, imazapic

Target species: These chemicals are generalists and control most species.

Accase inhibitor: clethodim

Target species: Monocots (plants with one seed leaf at germination- including grasses, orchids, lilies, irises, bluebells, ginger, onions, etc.) are susceptible to these herbicides.

A. Herbicide labels and safety data sheets (SDS)

The herbicide label is an important piece of information for utilizing. The label includes identifying information, safety information including what Personal Protective Equipment (PPE) is recommended to wear while using the herbicide and any side effects caused by exposure, environmental information intended to protect nontarget organisms, and use information. In the use information section you will find recommended application rates, methods, and target species the herbicide will control. Federal law requires using an herbicide in a manner consistent with its labeling.

The SDS is an OSHA regulated document which contains information on the herbicides physical and chemical properties, toxicological and ecological information, first-aid procedures, and emergency response. The SDS contains more technical information than the herbicide label.

B. Before using herbicides

Non-aquatic herbicides: each person using non-aquatic herbicides on state property needs to have a "right-of-way and natural area pest control" (Category 6) Wisconsin Pesticide Applicators Certification (expires every five years) or be supervised by a DNR staff person or volunteer who has Category 6 Certification.

Aquatic herbicides: If applying an aquatic herbicide below the high water mark each applicator needs to have an "aquatic and mosquito" (Category 5) Wisconsin Pesticide Applicators Certification.

Except for applications in aquatic environments, DNR staff (including volunteers) may apply general use pesticides on DNR land even though they are not DATCP certified, but they must be working under direction of someone who is. The certified personnel should be in work status at the time of the application or be present at the site of the application. Designated certified personnel are responsible for assuring that general use pesticide applicators are given instructions for responsible and safe usage, clean-up and storage procedures, including necessary Personal Protective Equipment (PPE).

Before using herbicides without DNR staff present, we recommend volunteers become familiar with the label and MSDS of the herbicide being used. The regional volunteer coordinator will provide a copy of the correct label and MSDS sheets. If you lose them or do not have a copy of the label or MSDS you can find them at:
http://www.cdms.net/LabelsMsds/LMDefault.aspx?t
The proper signage supplied by the regional volunteer coordinator must be in place when using herbicides. Warning signs must be posted at normal points of access to the application site and at any boundaries that lie within 300 feet of a residence, migrant labor camp, school, playground, day care facility, health care facility, commercial or industrial facility, public recreation area, or other nonagricultural area, except a public road, where individuals are likely to be present during the restricted entry interval specified on the pesticide label. Posting is required until sprays have dried or according to the pesticide label's Restricted Entry Interval.

C. Limiting exposure

Using proper Personal Protective Equipment (PPE) is important to limit direct exposure to chemicals. Wear long pants, long sleeved shirts, shoes, and socks free from holes. Since most of the exposure (one study indicated 85% of total exposure is on hands and 13% on the forearms) comes around your hands gloves can be great protective gear. We recommend using nitrile gloves at least 14 mils thick that have enough length to provide protection for your wrists as well. Remember to wash your hands before putting your gloves on and wash your gloves after handling herbicide to minimize exposure on other parts of your body.

For more information on herbicide use see these links:

DATCP Videos: http://datcp.wi.gov/Plants/Pesticides/Applicator_Video/index.aspx

DNR Herbicide Use Toolkit: http://intranet.dnr.state.wi.us/int/land/forestry/staff_tools/pesticides/

D. Herbicide considerations

- Consider what impact the herbicides will have on non-target species. Use herbicides when they will cause more good than harm on a site or when they are the most efficient option for controlling a specific species. Look into other alternatives if dealing with sensitive plant communities.
- Is there a timing application that will limit the effect on desirable species (ex: foliar spraying garlic mustard in the spring before desirable species come up or foliar spraying knapweed in the fall when desirable plants have browned down)?
- Think about how to store, mix, transport, handle, and dispose herbicides and their containers before obtaining herbicides.
- Follow federal, state, and local regulations. It is a federal law that herbicides must be applied according to the herbicide label.
- Check with the regional volunteer coordinator if you have questions regarding regulations or liability.
- Applicators must wear all PPE required by the herbicide label.
- How much public traffic is around? Could location of signage prevent exposure to the public?
- Use an aquatic herbicide if applying within a couple feet of standing water. The applicator will need to be certified as an aquatic and mosquito applicator.
- Consider forecasted weather conditions
  - High winds will increase drift which is not desirable.
  - As a general rule, do not apply herbicides above 90 degrees. Apply in the morning of hot days before plants adapt to hot conditions and are less likely to absorb the herbicide.
  - If applying water based herbicides to stumps, antifreeze can only work above 15 degrees or so.
  - Stop foliar spraying when temps get below 35 degrees.
  - Do not apply if there is a good chance of rain in the next couple of hours. Check the label to see if there is a more specific drying period.
  - Do not apply foliar spray if there is heavy dew on the foliage of target species. This will dilute the herbicide you are applying decreasing its effectiveness.

E. Herbicides recommended for use on SNAs

- **2,4-D Amine.** 2,4-D is commonly used on broadleaf species and was one of the original herbicides developed in the forties. The 2,4-D ester formula is not approved for use on SNAs due to its high volatility and potential to kill native plants due to drift. The 2,4-D amine version can be less effective than the ester, but still provides acceptable kill and can be used on SNAs. It is less expensive than some other broadleaf herbicides and will not kill monocots.
- **Aminopyralid.** Milestone is one example of a trade name for aminopyralid. This chemical came out in 2005 and is broadleaf specific. Since it is used in small quantities it has minimal impact on some broadleaves and tends to favor killing certain plant families like legumes and asters. It is especially effective on problematic invasives like spotted knapweed, crown vetch, black locust, Canada thistle, and some clonal species. Aminopyralid has a residual impact a few years after its use which may prevent seedling germination for

susceptible species. It can have two to three years control on spotted knapweed. It can be mixed with water or oil at recommended rates.

- **Clethodim.** Cledthodim is also known as Intensity. It is selective for grasses, and recommended for use on reed canary grass. However it is not aquatic approved, so application to water should be avoided.
- **Clopyralid.** One trade name for clopyralid is Transline. Like aminopyralid, clopyralid is effective on legumes and asters. However, the clopyralid label suggests not using it on sandy sites due to soil leaching. It is most commonly used on black locust, crown vetch, and thistles.
- **Glyphosate.** Glyphosate is commonly known as Roundup but goes under many other trade names. Some of these formulations are approved for aquatic use. Glyphosate is a non-selective herbicide and will kill most plants. Glyphosate is sometimes favored because it has minimal soil residual activity and tends to be less expensive than other herbicides.
- **Aminocyclopyrachlor + chlorsulfuron.** Aminocyclopyrachlor + chlorsulfuron is used on SNAs for treatment of leafy spurge. Its trade name is Perspective. The label gives specific instructions on time of year and application rates. This herbicide can have residual effects on other species so use carefully and sparingly.
- **Imazapyr.** Imazapyr comes in different forms and has a couple of trade names. An approved aquatic form of imazapyr is Habitat (generically known as Polaris). Stalker is one trade name of imazapyr for oil applications. Imazapyr is a non-specific herbicide and can kill most plant species. It is effective on difficult invasives like phragmites, narrow-leaf cattail, and unwanted brush species. It does have soil residual activity so may impact plants after application. It should be used with caution around canopy trees because it can travel from an invasive application through roots grafted on to larger trees and kill them. Treatments should not occur underneath the desirable tree drip line (the outermost circumference of the tree canopy where water drips down from leaves).
- **Liberate.** This chemical is a surfactant which helps the herbicide mixture spread out on the leaf surface and penetrate more of the leaf surface. It is better for use in aquatic environments that methylated seed oil and commonly used for those types of applications.
- **Methylated Seed Oil (MSO).** This chemical is a surfactant which helps the herbicide mixture spread out on the leaf surface and penetrate more of the leaf surface. It is commonly used in foliar applications as an addition to other herbicides to increase effectiveness.
- **Metsulfuron-methyl.** One trade name of metsulfuron-methyl is Escort. Metsulfuron-methyl is effectively used on broadleaves for both post and pre-emergence due to its residual activity in the soil. It is thought to be a selective chemical, allowing some natives to persist after spraying. Target species may take longer to show signs of application.
- **MCPA, Triclopyr, Dicamba.** These chemicals are combined to form a herbicide with a trade name of Progeny. This herbicide can be used for woody species and other broadleaf control. It is selective on broadleaf weeds.
- **Triclopyr.** Triclopyr is the chemical name of Garlon 3A and Garlon 4. It is an effective broadleaf specific herbicide that will not kill monocots and is very effective on many common woody species. Garlon 3A cannot be mixed in oil but is approved for use in aquatic environments. Generic versions are Element 3A and Element 4. We commonly use triclopyr for woody species such as buckthorn, autumn olive, garlic mustard, mesic tree species, etc. It is very effective on broadleaf species.

F. Storage and transporting

It is important to consider how you are planning to store and dispose of herbicides before you receive them. Most herbicides need protection from extreme cold, heat, and moisture. Keep them in an area with temperatures ranging between 40-100° F. In colder temperatures some herbicides break down or could freeze and cause ruptures. Herbicides should be kept in a secure area where unauthorized people or animals are unable to get to. The storage area should be able to withstand chemical spills. A sealed floor would prevent any runoff from getting to ground water. Metal or plastic shelves are ideal for storage because they are easy to clean in the case of a spill. An absorbent material like kitty litter can be used to stop and clean spills. Ventilation will help prevent fumes from building up.

It is difficult to tell how long a herbicide will last before breaking down. When acquiring new herbicide, mark the containers with the date received and use the old ones up first. Try to only have enough herbicide on stock for a year or field season.

When transporting herbicides, use containers that will catch spills due to tip-over such as a 5 gallon bucket or large Rubbermaid tote. Keep paper towels, kitty litter, a dustpan, and a supply of water with you in case spills do occur.

G. Mixing, loading, rinsing

Sometimes calculating the correct amount of herbicide can be a challenge. To mix an herbicide at a solution of 25% calculate how much herbicide concentrate to use by multiplying the total amount of mixed herbicide desired by 25%. For example if 2 gallons of 25% triclopyr in oil were needed, determine the total ounces you would need. 128 ounces/gallon x 2= 256 ounces. Multiply 256 x 0.25 = 64 ounces. Fill the container with 64 ounces of triclopyr and then add oil to the 2 gallon mark. If the oil is added first to the two gallon mark your mixture will be dilute and you will have more than 2 gallons.

Most herbicide exposure happens during mixing and loading. Since chemicals are undiluted the chance of exposure is high. Avoid dermal exposure to concentrated herbicide by wearing proper PPE which includes long-sleeved clothing, chemical resistant gloves, and eye protection when mixing and loading. Have an extra supply of water and soap with you in case exposure occurs. Try to determine how much chemical you will need that day and don't mix much more than what you will use.

After each use rinse mixing equipment (funnels, measuring cups, etc.) and herbicide sprayers in the field. Triple rinse with water (rinsing the inside of the container with 10-20% filled capacity and dumping the rinsate water out three times) and spray through wands to remove any residual herbicide so it does not corrode moving parts. You will produce a rinsate by doing this which can be saved and used for future applications but we recommend discarding it on a site where you have used the herbicide. When mixed with water, oil based herbicides will form a sludge that is unusable. It is best to rinse oil-based herbicide containers on site and dispose the rinsate there.

Remember to keep track of how much herbicide you use during the day and report the concentrated herbicide amount in the volunteer log. It is required by law that the program reports its herbicide usage. For workdays it might be helpful to determine how much you have at the beginning and subtract that from how much you have left at the end of the day.

After working, wash hands and arms with soap and water. Keep an extra change of clothes in your vehicle in case of spills. Wash clothing worn during applications separately from other clothing to prevent cross contamination. After the work is over, take a shower as soon as possible to remove any residual herbicide from your skin.

Disposal

After using herbicides you will end up with empty containers. These containers can go to a landfill after being triple rinsed with water and punctured.

If you have unwanted liquid a landfill will not accept it. These can be disposed at a Wisconsin Clean Sweep site but will require a substantial fee. It is best to avoid accumulating any kind of liquid waste by applying it all on site.

Application methods

The method of application varies based on seasonality, species, effectiveness, and personal preference. These are all good options to consider when removing invasive plants.

- **Basal bark.** Spraying a band of oil based herbicide on the lower bark of a tree. The band touches the ground level and extends up twice the width of the tree. The herbicide seeps in through the bark and gets absorbed by the plant. Larger trees with corky bark may not die or may take over a year to show signs of treatment. Basal barking works well for smaller to moderate sized trees but can use a large amount of chemical.
- **Cut stem.** Using a tool to cut a tree down and applying a chemical to the stump left after cutting. This is a common method used in the winter to kill invasive trees and brush. Herbicide can be applied with a hand sprayer, wick applicator, or backpack sprayer. The entire cambium (the plant tissue between the bark and wood of trees) needs to be treated with herbicide in order to kill the tree. Many labels also suggest applying the herbicide further down the cut stem. Resprouts may still occur the next year and follow-up treatments may be needed.
- **Foliar boom spray.** A larger motorized or electrical sprayer powers multiple spray heads mounted on a long tube or boom that sprays herbicide. This equipment is often mounted on an ATV, truck, tractor, or helicopter that travels over the target area as it sprays. Boom spraying is effective for covering large areas with dense stands of target species but may threaten non-target species with drift.
- **Foliar spot spray.** One of the most common methods of applying herbicide is using a sprayer to build pressure and spray a liquid chemical on target plant leaves. A surfactant is needed to break down the tendency of water molecules to stick together. The surfactant allows the herbicide to spread over more of the leaf and penetrate into the plant cuticle, a thick waxy layer present on most plants. One of the drawbacks to using a foliar spray application is the damage caused to native plants via drift. It is beneficial to spray when drift is minimal due to season or low wind. A favorable season for minimizing drift may be in the spring or fall when target individuals are smaller or in the rosette stage. Auxin mimic herbicides are typically most effective when the target species is growing most aggressively (typically just before flower stage).
- **Foliar wick application.** Using a wicking or wiping tool can be a way to minimize impact to non-target species. For example, the glove of death method pairs a cheap fuzzy glove outside with a chemical glove on the inside. A container of herbicide is carried; the outside glove is dipped in the container and wicked on the target species to apply the herbicide. This method often uses a higher concentration of herbicide than foliar spraying. It can be effective at eliminating more scattered individuals but time consuming.

- **Girdle.** Removing the living tissue (cambium layer or bark) to prevent nutrient flow from the leaves to the roots. Girdling is moderately effective on clonal problem species like aspen but can also work on walnut, ironwood, and others. It tricks the plant from thinking it has been harmed by leaving the heartwood intact and discouraging resprouting. After a growing season or two girdled trees will die unless healing or resprouting occurs. Removing the outer bark is possible when sap is flowing- usually in late spring to early summer. A sharp tool is needed to cut into the bark, then the bark is pried off.
- **Hack and squirt (Frill).** A sharp tool is used to cut into the bark in several places and an herbicide is applied to that cut at a high concentration. This method may work on large trees or clonal species.

References:

Tomasko, S., R. Flashinski, and M. Renz. 2009. “Wisconsin Pesticide Applicator Training Manual- Right-of-way.” 6th ed. University of Wisconsin Press: Madison.

Williams, B. 2011. “The Stewardship Manual.” Draft.